"Before concluding these observations on the subject of the Fine Arts, it is necessary to notice the important subdivision of *Architecture*. Of all the higher branches of art, it is the one which may be said to require the most varied degree of instruction, and to be connected with the greatest number of branches of practical science. An acquaintance with the properties of raw materials, a knowledge of physics, of chemistry, of manufactures, are alike indispensable to its correct appreciation; but although this truth has long been acknowledged and acted upon in other countries, it has not been so with us to the extent that might be desired.

The necessity of a more perfect system of artistic instruction, as already shown by us in the case of painting, is equally a necessity in this instance; and we may observe that the collection of casts made by Government on the occasion of the building of the new Houses of Parliament, and *ultimately destined*, as we have mentioned, *for a National Museum of Mediæval Art*, would, if only as a nucleus, form a most valuable object of study in this department."

Reference is made in the Report to Dr. Playfair's lecture on Industrial Instruction on the Continent, to show what we shall have to compete with. It is calculated that in Germany alone 13,000 men annually receive the technical and scientific training of the Trade Schools and Polytechnic Institutions, while more than 30,000 workmen are being systematically taught the elements of science and of art, in schools which communicate instruction to them in their leisure hours. This lecture is now published, and deserves the attention of all who are interested in our Industrial Progress, even though they may think with us that up to this time the schools in Germany have produced smaller results than might have been expected. "The whole of industrial competition," says the writer, "is now resolved into a struggle to obtain a *maximum* effect by a *minimum* expenditure of power. But this power is derived from natural forces, and not from brute strength: mental labour has engrafted itself upon muscular effort, and, by a healthy growth, has reduced the size and relative importance of the latter. Every new acquirement in the knowledge of natural forces is the acquisition of a new sense, which may be applied to production; and as every substitution of a natural force for muscular exertion depends upon a knowledge of the former, it surely requires no argument to prove, that the economical application of it must rest upon a perceptive and not merely empirical knowledge; or, in the language of the Wise King of Scripture, 'If the iron be blunt, and we whet not the edge, then must we put to more strength; but wisdom is profitable to direct.'"

Let us make that preparation for the fight which common sense teaches us is desirable: with wisdom *and* strength there need be no fear as to the result.

HOW TO DETERMINE THE BEVELS IN THE QUOINS OF AN OBLIQUE CIRCULAR SEGMENTAL ARCH, THE COURSES RUNNING IN THE DIRECTION OF ABUTMENTS.

In No. 493 of this journal, there is given a method of assigning the moulds for the bevels when the arch is semicircular, and the same method, under certain modifications, is applicable when the arch is segmental, with the courses running in the direction of the abutments: hence the solution of the following question can be effected by the rules previously given.*

* See page 460, *ante*.

Question. — What are the bevels of the quoins, and the forms of the coursing joints, in an oblique circular segmental arch of nineteen equal courses, the span being 35 feet 4 inches, and the versed sine or rise 12 feet, the obliquity or deviation from the square being 45 degrees?

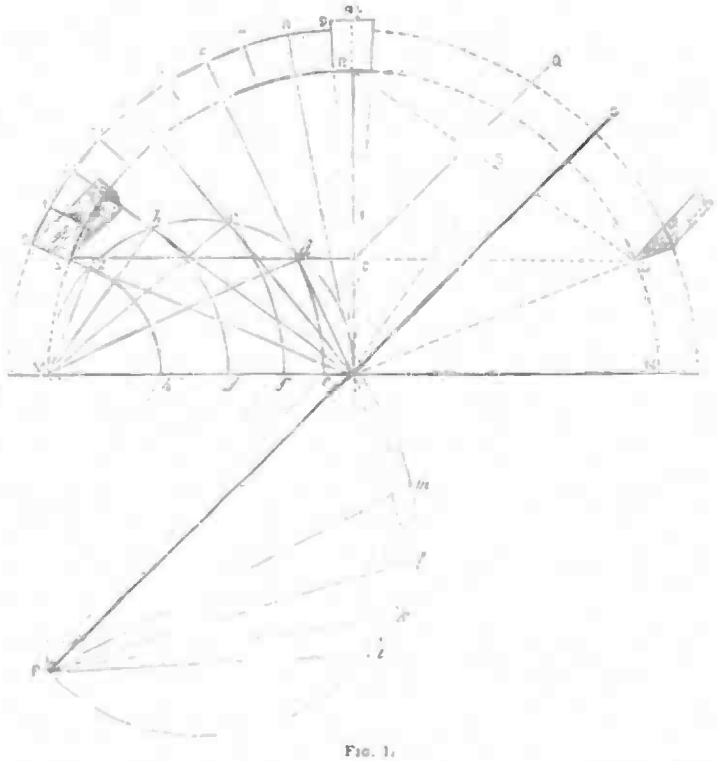

Fig. 1.

35½ feet, taken from a scale of equal parts of any convenient dimensions, to represent the span of the arch: bisect the span AB, perpendicularly in C, and make CR equal to 12 feet, the given rise or versed sine, and draw the chord RB. Bisect RB perpendicularly in S, and let SV meet RC produced in V; then is V the centre of the circle, of which the proposed arch is a segment. Describe the semicircle MARBN, and divide the semi-arch AR, into 9½ parts, the number of courses between the crown and the abutment, and draw the several radii to represent the direction of the beds or joints of the courses, which would all meet in the point V, if extended down to that plane; but to avoid confusion in the figure, it will be sufficient to draw only every other radius, beginning at the abutment.

Upon the straight line MV as a diameter, describe the semicircle M*abcd*V, intersecting the radii 0V, 2V, 4V, and 6V in the points *a*, *b*, *c*, and *d*; then with the distances M*a*, M*b*, M*c*, and M*d*, describe arcs to meet the semi-diameter MV, in the points *h*, *g*, *f*, and *e*. At the point M erect the perpendicular MP, and through the centre, V, draw the straight line CVP, making with the diameter MN an angle of 45 degrees, the given obliquity, and meeting MP in P; then is the straight line PVG parallel to CQ, the central line of the arch, and in the direction of the abutment BW: it is therefore manifest, that the planes of all the beds or coursing joints, would pass through the line PVG.

Draw the straight lines P*h*, P*g*, P*f*, and P*e*, and on PV as a diameter, describe the semicircle P*ikl*m*V*, in which inflect the straight lines P*i*, P*k*, P*l*, and P*m*, respectively equal to P*h*, P*g*, P*f*, and P*e*, and draw V*i*, V*k*, V*l*, and V*m*; then are the angles P*h*M, P*g*M, P*f*M, P*e*M, and their supplements P*h*V, P*g*V, P*f*V, and P*e*V, the bevils of the quoins for both sides of the arch; and in like manner the angles PV*i*, PV*k*, PV*l*, PV*m*, with their supplements GV*i*, GV*k*, GV*l*, and GV*m*, are the angles between the joints in the face of the arch and the joints along the soffit for both semi-arches, and by these angles respectively the moulds for voussoirs of the whole arch are constructed.

In order to render the solution of this question intelligible, it becomes necessary in the first place to delineate the arch, and to show how the bevels are obtained geometrically, as this will be the means of leading to the mode of calculation; for which purpose, draw the straight line AB, fig. 1, and make it equal to

THE COMPUTATION OF THE ANGLES.

In order to compute the angles of bevel, it is necessary in the first place, to ascertain how much of the arch is occupied by a single course; and for that purpose, we have given the semi-span AC=17 feet 6 inches, and the rise or versed sine CR=12 feet, and by these the whole angle AVR can be determined, and hence the angle subtended by each course becomes known.

It is a well-known principle in geometry, that the square of half the chord of an arc of a circle, *is equal to the rectangle or product of the two segments of the diameter which bisects the chord*; therefore, if to the square of half the chord CA, we add the square of the versed sine CR, and divide the sum by twice the versed sine, we shall obtain the radius VA: then in the right-angled triangle ACV, there are known, the hypothenuse AV and the side AC, by which the angle AVC can easily be found. Thus we have,—

Half of chord CA=17 ft. 6 in.=17·5 ft. its square	306·25	
Versed sine CR	= 12 ft. its square	144
Sum of the squares	450·25	log. 2·6534059
Twice the versed sine CR	24 ft.	log. 1·3802112
Radius AV	18·75 ft.	log. 1·2731947 subtract
Semi-chord AC	17·5 ft.	log. 1·2427528
Required angle AVC 68° 24′		log. sin. 9·9663419

Now, since there are to be 9½ courses between the abutment and the crown of the arch, if we divide the angle 68° 24′ by 9½, we shall get 68° 24′ ÷ 9½ = 7° 12′, the space of the arch occupied by each course.

If from the quadrant MVR we subtract the computed angle AVR, we have 90° − 68° 24′ = 21° 36′ for the angle AVM, the portion of the quadrant which brings us to the springing joint; therefore, by adding 7° 12′ continually, we shall obtain the angles for each joint from the abutment to the crown of the arch. The angles are therefore as follow:—

1.	Angle AVM	90° − 68° 24′ = 21° 36′
2.	Angle MV1	21 36 + 7 12 = 28 48
3.	Angle MV2	28 48 + 7 12 = 36 0
4.	Angle MV3	36 0 + 7 12 = 43 12
5	Angle MV4	43 12 + 7 12 = 50 24
6.	Angle MV5	50 24 + 7 12 = 57 36
7.	Angle MV6	57 36 + 7 12 = 64 48

To learn how to use OCR and PDF Compression visit our website